SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

For High-Speed Switching and Linear-Amplifier Applications in Military, Industrial, and Commercial Equipment

2N5415, 2N5416 — P-N-P Complements of: 2N3440, 2N3439

RCA-2N5415 and 2N5416* are triple-diffused silicon p-n-p transistors with high breakdown voltages, high frequency response, and fast switching speeds.

These transistors differ primarily in their voltage ratings. Typical applications include high-voltage differential and operational amplifiers; high-voltage inverters; and high-voltage, low-current switching and series regulators.

*Formerly RCA Dev. Types TA2819 and TA2819A, respectively.

FEATURES

- **Maximum area-of-safe-operation curves**
- **High voltage ratings:**
  V_{CBO} = – 350 V max. (2N5416)
  $V_{CEO(sus)}$ = – 300 V max. (2N5416)
  – 200 V max. (2N5415)
- **Reliability data available†**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N5415	2N5416	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	–	- 350	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With base open, $V_{CEO(sus)}$	- 200	- 300	V
With external base-to-emitter resistance (R_{BE}) = 50 Ω, $V_{CER(sus)}$	–	- 350	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	- 4	- 6	V
COLLECTOR CURRENT, I_C	- 1	- 1	A
BASE CURRENT, I_B	- 0.5	- 0.5	A
TRANSISTOR DISSIPATION, P_T			
At case temperatures up to 25°C	10	10	W
At case temperatures above 25°C	*See Figs. 1 & 2.*		
At ambient temperatures up to 50°C	1	1	W
At ambient temperatures above 50°C		Derate linearly at 6.7 mW/°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)	– 65 to + 200		°C
LEAD TEMPERATURE (During Soldering):			
At distance ≥1/32 in. (0.8 mm) from seating plane for 10 s max.	255		°C

† Reliability Report REL-100 (11/67) Available on request from RCA Commercial Engineering Harrison N.J. 07029.

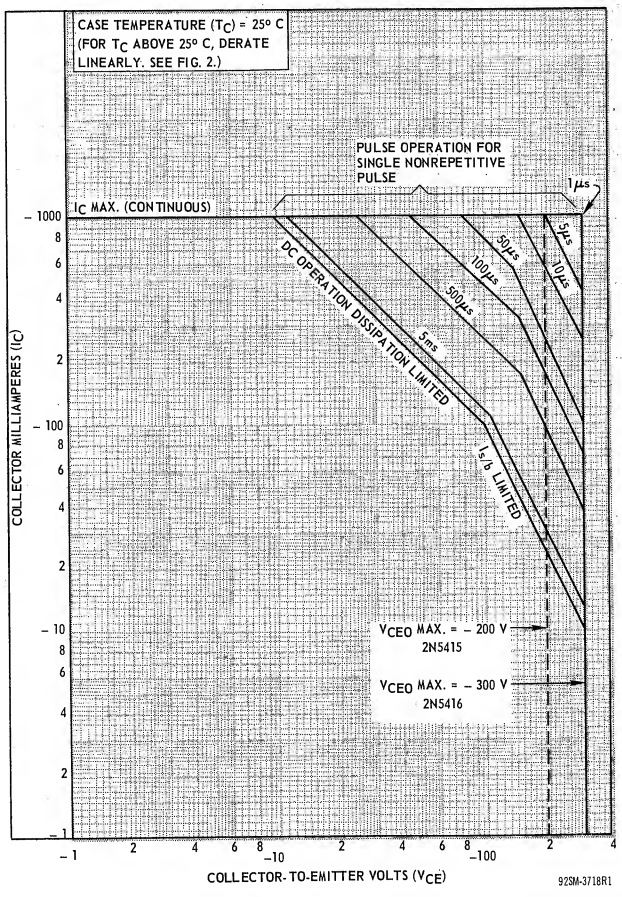

Fig. 1 – Maximum Safe Operating Areas for Types 2N5415 & 2N5416

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25° C*

Characteristic	Symbol	TEST CONDITIONS: DC Collector Voltage (V) V_{CB}	V_{CE}	DC Emitter or Base Voltage (V) V_{EB}	V_{BE}	DC Current (mA) I_C	I_E	I_B	LIMITS: Type 2N5415 Min.	Max.	Type 2N5416 Min.	Max.	Units
Collector-Cutoff Current	I_{CEO}		-250					0	–	–	–	-50	μA
			-150					0	–	-50	–	–	
	I_{CEV}		-300		1.5				–	–	–	-50	μA
			-200		1.5				–	-50	–	–	
Emitter-Cutoff Current	I_{EBO}			-6		0			–	–	–	-20	μA
				-4		0			–	-20	–	–	
DC Forward-Current Transfer Ratio	h_{FE}		-10			-50			–	–	30	120	
			-10			-50			30	150	–	–	
Collector-to-Emitter Sustaining Voltage: With base open *(See Fig. 5 & 6.)*	$V_{CEO}(sus)$					-50		0	-200[a]	–	-300[a]	–	V
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$					-50			–	–	-350[a]	–	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$		-10			-50			–	-1.5	–	-1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					-50		5	–	-2.5	–	-2	V
Small-Signal, Forward-Current Transfer Ratio (at 5 MHz)	h_{fe}		-10			-10			3	–	3	–	
Output Capacitance (at 1 MHz)	C_{ob}	-10					0		–	15	–	15	pF
Second-Breakdown[b] Collector Current: With base forward biased[c]	$I_{S/b}$[d]		-100						-100	–	-100	–	mA
Thermal Resistance: (Junction-to-Case)	θ_{J-C}								–	17.5	–	17.5	°C/W

[a]**CAUTION:** The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. The sustaining voltage should be measured by means of the test circuit shown in Fig. 5.

[b]Regions for safe-operation with forward bias are shown in Fig. 1.

[c]Specified value of $I_{S/b}$ for given value of V_{CE} as base voltage is increased from zero in a positive direction.

[d]$I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage.

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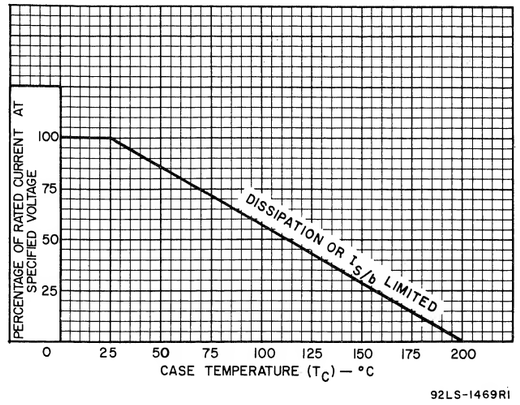


Fig.2 – Dissipation Derating Curve for Types 2N5415 & 2N5416

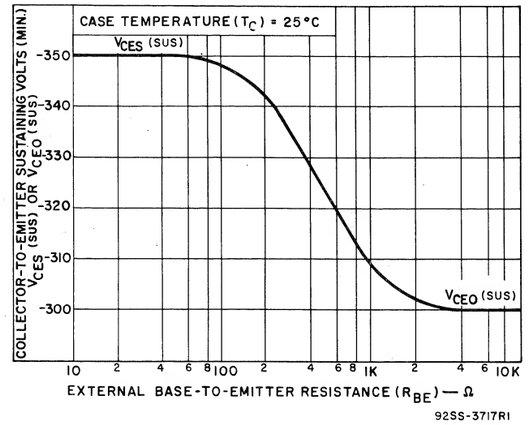


Fig.3 – Sustaining Voltage vs. Base-to-Emitter Resistance for Type 2N5416

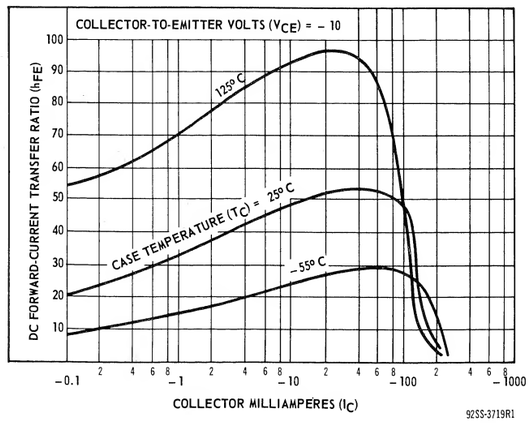


Fig.4 – Typical DC Beta for Types 2N5415 & 2N5416

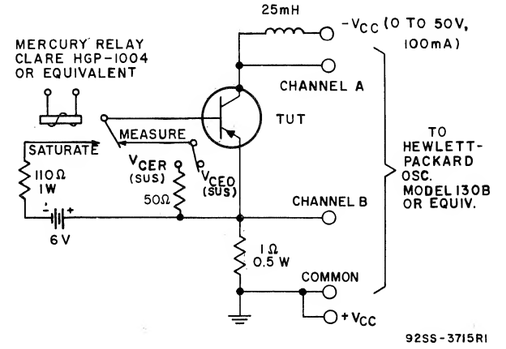
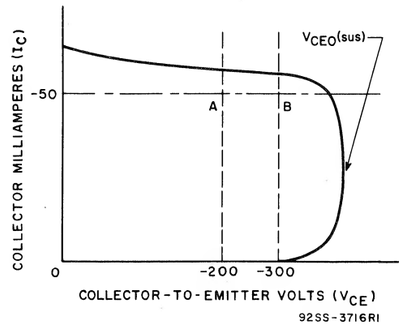


Fig.5 – Circuit Used to Measure Sustaining Voltages, $V_{CEO}(sus)$ and $V_{CER}(sus)$ for Types 2N5415 & 2N5416



The sustaining voltage V_{CEO} (sus) is acceptable when the trace falls to the right and above point "A" for type 2N5415 The trace must fall to the right and above point "B" for type 2N5416.

Fig.6 – Oscilloscope Display for Measurement of Sustaining Voltages (Test Circuit Shown in Fig.5)

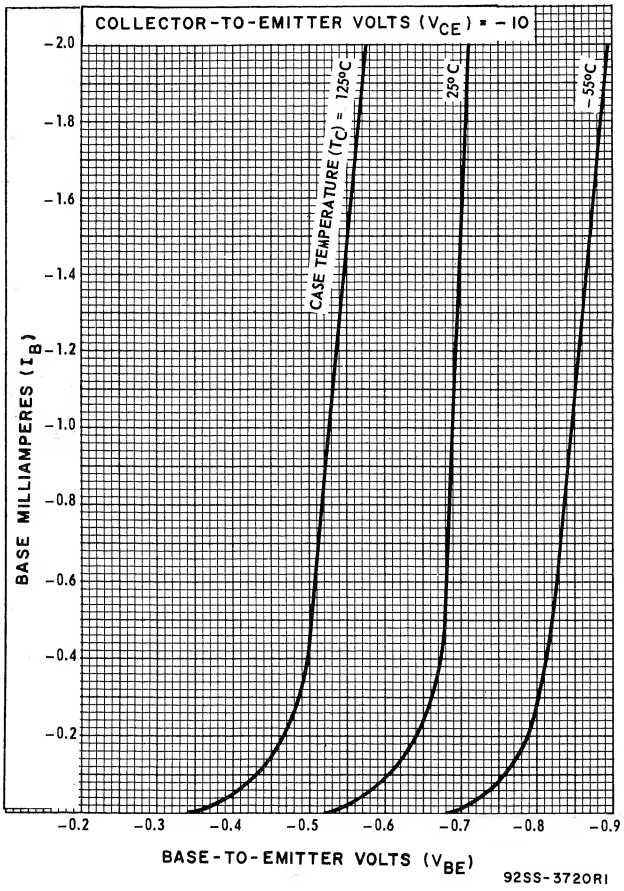


Fig.7 – Typical Input Characteristics for Types 2N5415 & 2N5416

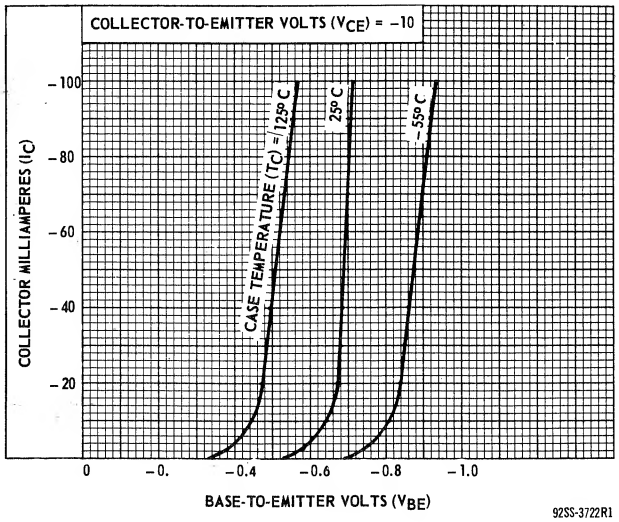


Fig.9 – Typical Transfer Characteristics for Types 2N5415 & 2N5416

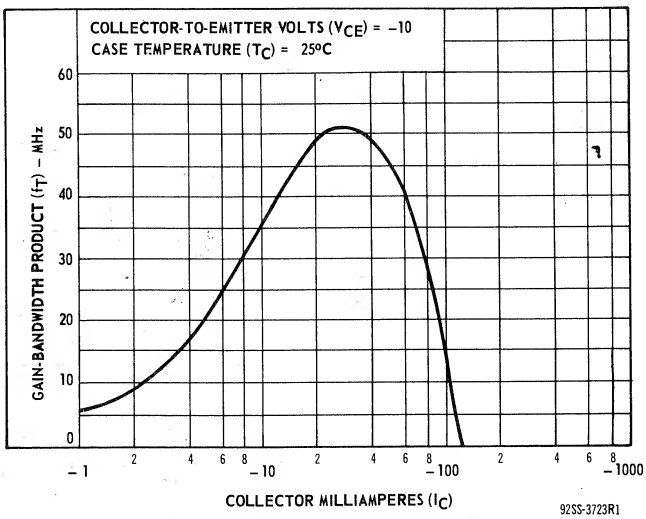


Fig.10 – Typical Gain-Bandwidth Product for Types 2N5415 & 2N5416

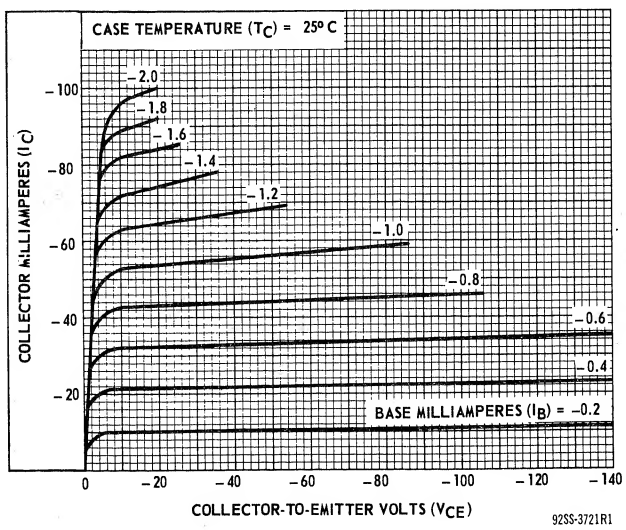
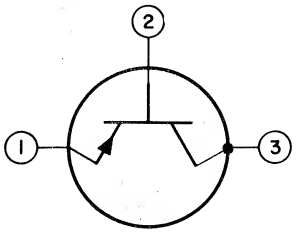


Fig.8 – Typical Output Characteristics for Types 2N5415 & 2N5416

DIMENSIONAL OUTLINE FOR JEDEC TO-5

The 2N5415 & 2N5416 employ the JEDEC TO-5 package. The dimensional outline for this package is shown in the RCA SEMICONDUCTOR PRODUCTS DATABOOK (Form No. SPD-100) and in the RCA TRANSISTOR MANUAL (Technical Series SC-13). Also, copies of this dimensional outline can be obtained from RCA, Commercial Engineering, Harrison, N.J. 07029.

TERMINAL DIAGRAM



Lead No.1 - Emitter
Lead No.2 - Base
Lead No.3 - Collector, Case